Introduction
It is estimated that 50% of the working population will experience significant back pain and sciatica at some point in their working lives (1). A significant proportion of patients with low back pain and sciatica will suffer a bulging or prolapsed disc. In such situations, the disc may be removed and the patient’s symptoms may resolve rapidly. In a significant proportion of patients there is disc resorption, with collapse of the disc space and bony encroachment on the neural foramina. The Holmium: YAG laser has been adapted for orthopaedic application, but its use remains controversial (2). A proportion of patients will respond to laser discectomy with excellent results. With other patients, the effect is less marked and, in a small proportion of patients, the symptoms are exacerbated. There is concern that there may be excessive heating of the neural tissues. Nevertheless a side-firing laser does offer the potential for removal of bone from the neural foramina with a minimally invasive technique using endoscopy, that does not involve major spinal exploration (2).

Materials and Methods
Cadaveric lumbar sheep spines were used for these experiments. The lumbar spines were precisely excised and dissected to maintain normal anatomy, especially with regard to the nerve roots. The dissected spines were stored at –20°C until the day of the experiment. Before starting the experiment the lumbar spines were defrosted by leaving the specimen at room temperature for 12 hours.

Measurement of Foraminal Dimensions
The horizontal and vertical diameters of the intervertebral foraminae at level L6/7 were measured on both sides by use of a small hole probe (Radio Spares) together with a Vernier Calliper. These measurements were repeated at the end of the experiment after ablation.

Temperature Measurement
T-type thermocouples, 100 µm in diameter and constructed from copper and constantan, were inserted through 18-gauge hypodermic needles into the nerve roots, dura mater and disc spaces; a further thermocouple was used to monitor the temperature in the water bath. Advantages of fine thermocouples include the potential for accurate placement of the probe tips relative to the laser tip. The smaller the diameter of the probe the faster the time constant, and the shorter the temperature transients that can be detected. The voltages from these thermocouples were detected by a thermocouple measuring board inserted into a desktop PC. Once the thermocouples had been positioned, the spine was placed in a water bath at 37°C. Temperatures in the nerve roots, dura mater, disc space and water bath during ablation were recorded at 1 Hz.

Laser Ablation
A Ho:YAG laser was used for the experiments (VersaPulse, Coherent (UK) Ltd). This is a pulsed laser with a 250 µs pulse of light at 2.1 µm. The laser fibre was 400 µm in diameter. A total energy of 4.6 kJ was used in each experiment. In the first set of experiments, both foraminae at the L6/7 level were ablated (n=8), either with low power (10 J/s) or high power (22.5 J/s). In a second set of experiments (n=5), the effect of saline irrigation (27 ml/min at room temperature) on the temperatures during high power laser ablation was measured.

Results
Laser ablation increased the dimensions of the foraminae by approximately 1 mm. A typical example of the output from the thermocouples is shown in Figure 1. Temperatures start to increase as soon as ablation is started. In some experiments, there are occasional transient peaks seen in the temperature profiles. Mean temperatures from the experiments are shown in Table 1. There is no difference in temperature increase between low and high power use.